DECADE-TO-DECADE STABILITY OF BRIGGS, ET AL. BUILDINGS CLIMATE ZONE BOUNDARIES OVER VARIOUS REGIONS OF THE GLOBE

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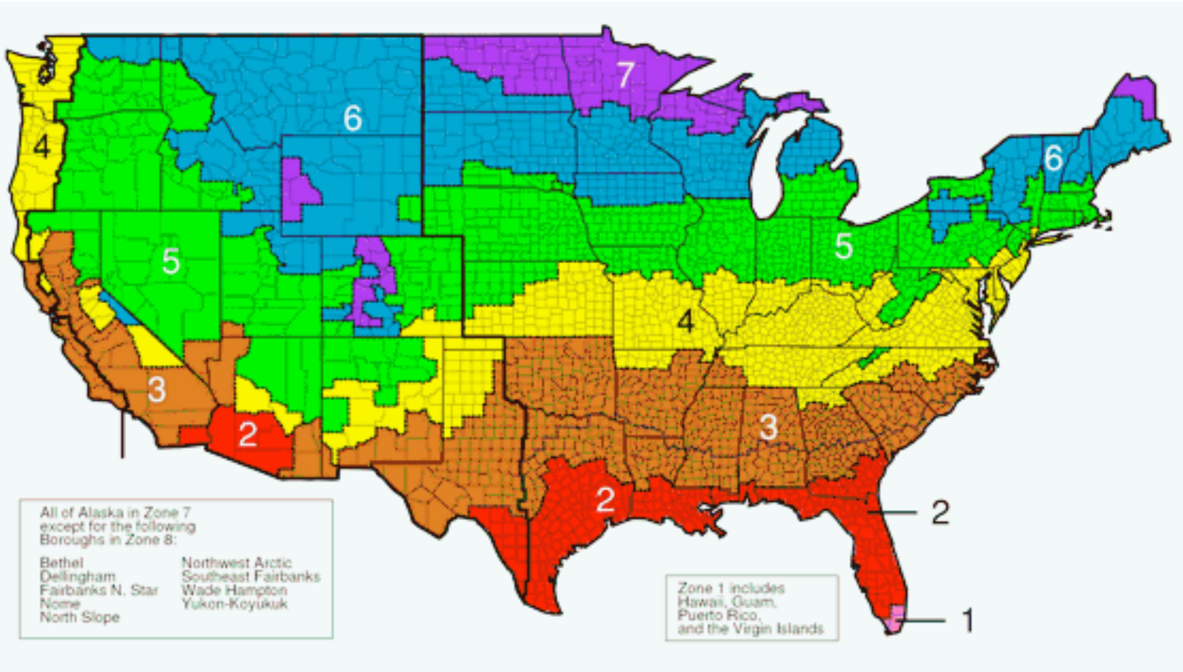
BACKGROUND INFORMATION

SUMMARY OF BRIGGS, LUCAS, AND TAYLOR BUILDINGS CLIMATE CODE STATEMENTS FROM SECTION 4.4 www.energycodes.gov, 2000

1. EVERY COUNTY IN U.S. WAS MAPPED WITH A SINGLE-CODE TO SIMPLIFY USE.

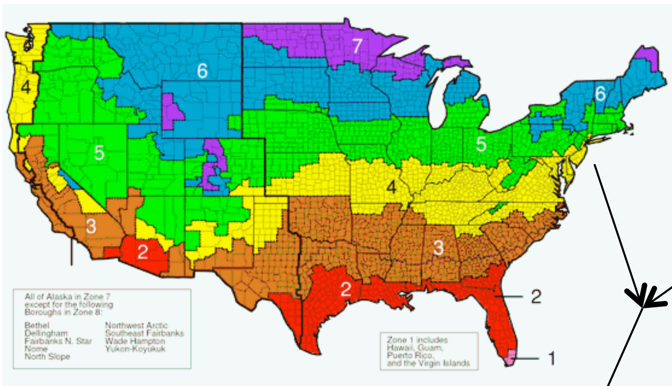
2. ELEVATION HAS A LARGE IMPACT ON CLIMATE WITHIN A COUNTY. OTHER CLIMATES SHOULD BE ALLOWED INSIDE COUNTIES.

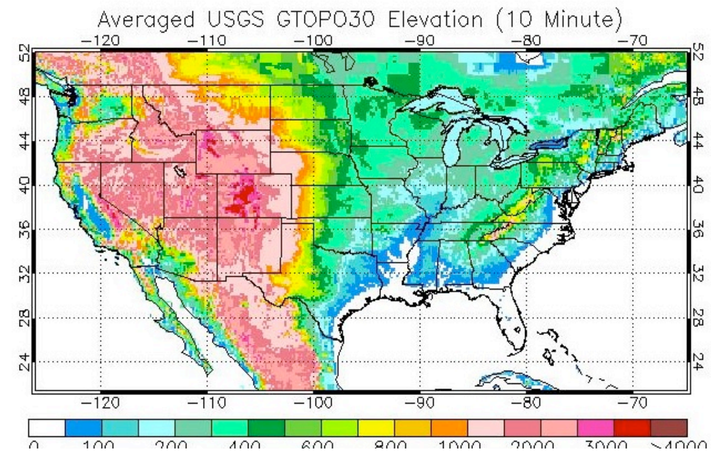
3. <u>WITHIN-COUNTY ELEVATION DIFFERENCES REMAIN UNRESOLVED IN CURRENT DOE/ASHRAE COUNTY ENERGY CODES</u>.

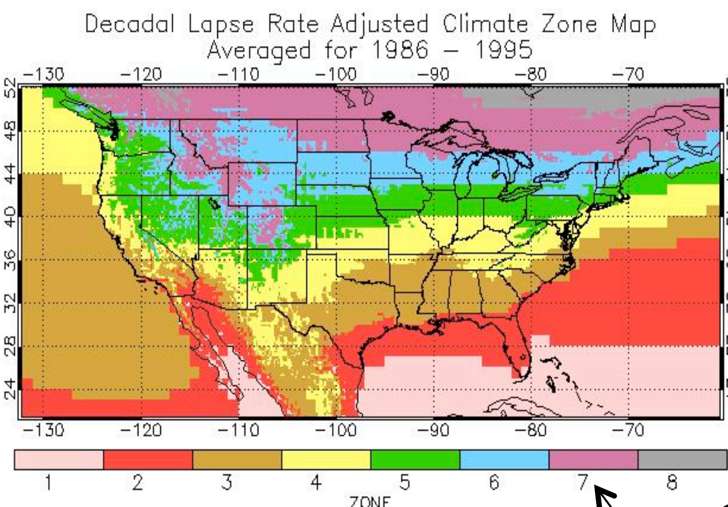


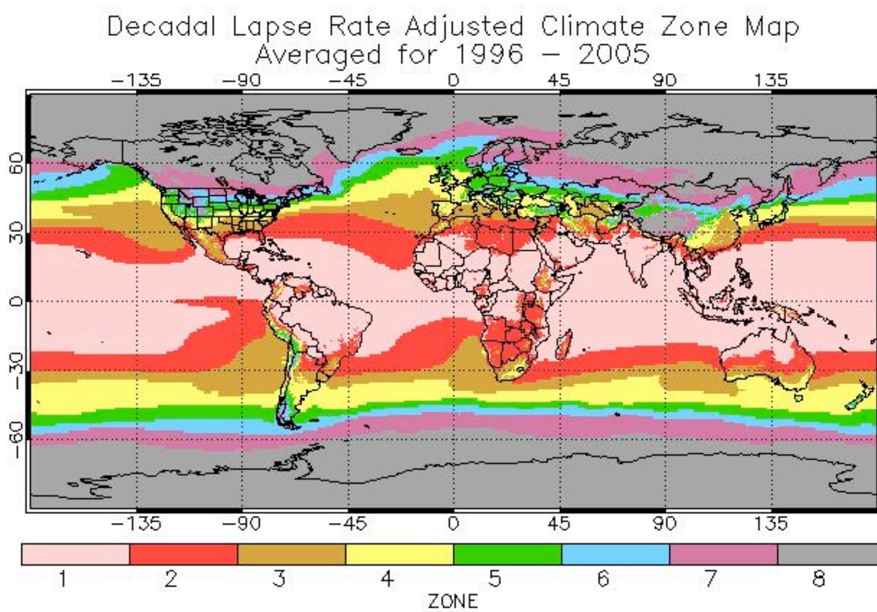
METHODOLOGY FOR HIGH SPATIAL RESOLUTION DECADE-TO-DECADE ANALYSIS

DOE/ASHRAE COUNTY-WIDE RESOLUTION METHODOLOGY





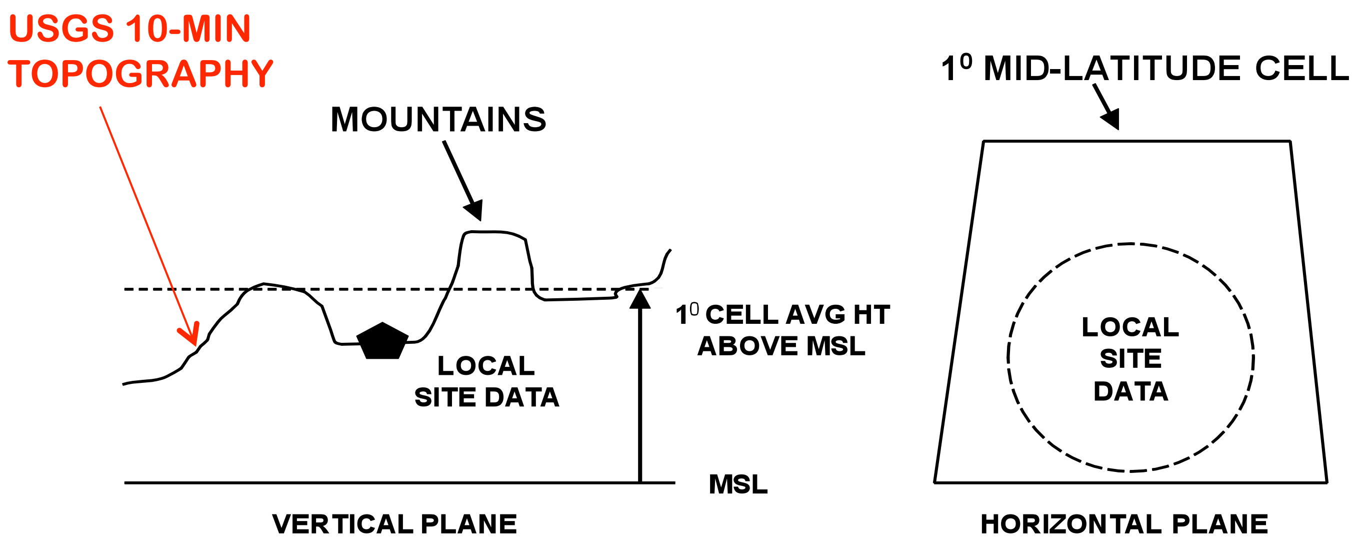




10-MINUTE LAT/LON SPATIAL RESOLUTION

ORIGINAL NASA 1-DEGREE CELL SIZE MODEL

REANALYSIS MODEL CELL VERSUS NCDC LOCAL-SITE GEOMETRY



REANALYSIS TEMPERATURES, WINDS, PRESSURES, ETC. MAY NEED LOCAL CORRECTIONS IN MOUNTAINS & CITIES.

LAPSE-RATE TEMPERATURE CORRECTIONS FOR WITHIN-CELL TOPOGRAPHY VARIATIONS ARE NEEDED!

BASIC METHOD FOR ADJUSTING GEOS-4 1-DEGREE CELL SIZE TEMPERATURES TO ESTIMATE 10-MINUTE CELL-SIZE TEMPERATURES

$$T^{(10\text{-min})} = T^{(1\text{-deg})} – [(H_{1\text{-deg}} - H_{10\text{-min}}) * \text{Lapse Rate})] – (\text{Offset})$$

where H is the height above sea level in km for Tmax, Tmin, and Tavg

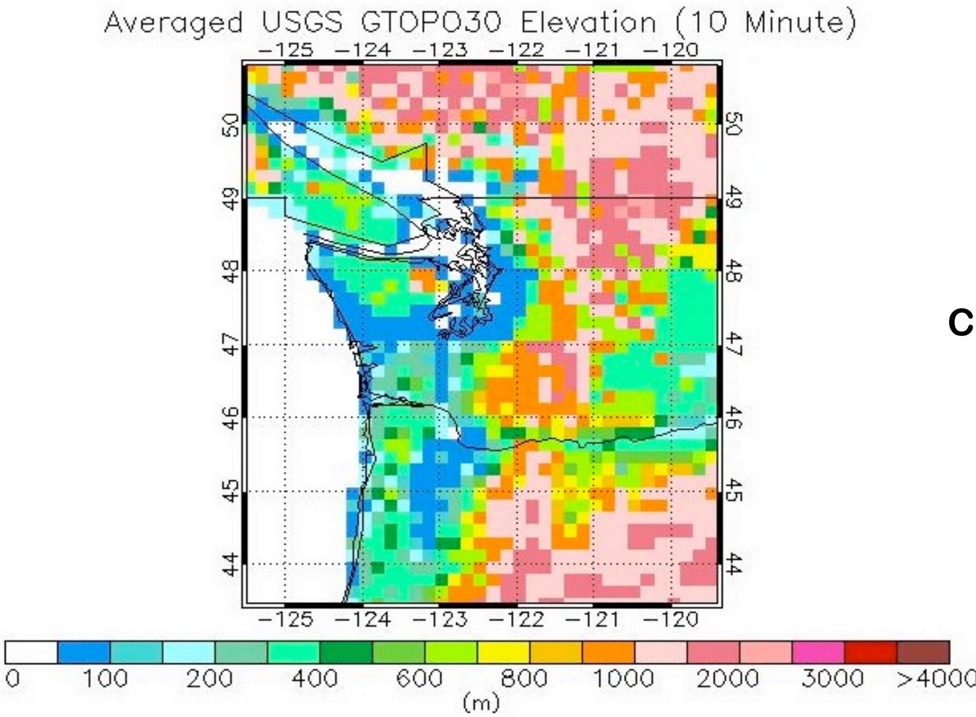
	Lapse Rate (^{0}C/km)	Offset
Tmax	-6.22	-1.29
Tmin	-4.66	+0.66
Tavg	-5.34	-0.10

and :

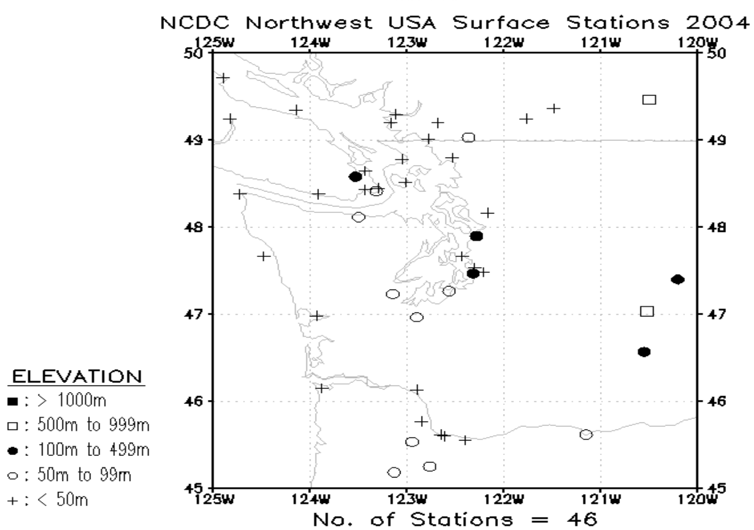
$T^{(10\text{-min})}$ = new 10-minute cell temperature
$T^{(1\text{-deg})}$ = known GEOS-4 1-degree cell temperature
$H_{1\text{-deg}}$ = known 1-degree cell height
$H_{10\text{-min}}$ = known 10-minute cell height

NOTE:
The above equations were obtained by comparison with highest quality 1983-2006 NCDC site data with NASA GEOS-4 1-degree cell height temperatures over the globe for the 8 DOE/ ASHRAE buildings climate zones. See http://eosweb.larc.nasa.gov, go to Methodology, then Section VIII, Meteorological Parameters , equation VIII-1.

PRIMARY PACIFIC-NORTHWEST U.S./CANADA VALIDATION SITE



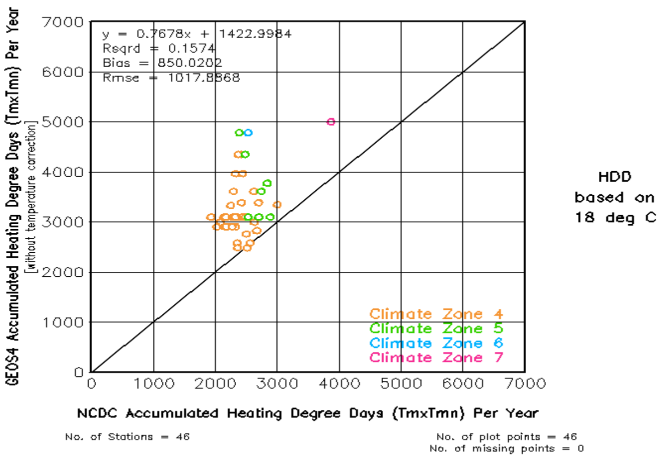
COMPLEX MOUNTAIN/COASTAL VALIDATION REGION



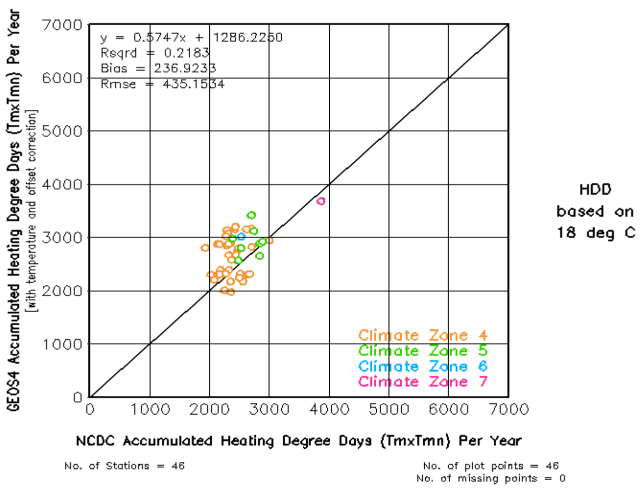
NCDC METEOROLOGICAL STATIONS IN REGION

(MAP SIZES HAVE BEEN ADJUSTED TO EQUAL SURFACE DISTANCES)

2004 COMPARISON USING HEIGHT AND OFFSET ADJUSTMENT EQUATIONS AT 46 SITES IN THE PACIFIC NORTHWEST REGION OF THE U.S. AND CANADA



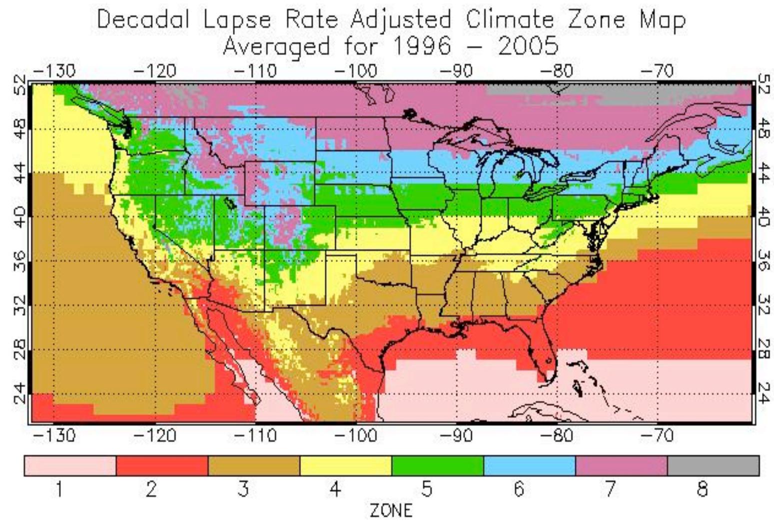
WITHOUT HEIGHT/OFFSET-ADJUSTMENT EQUATION



WITH HEIGHT/OFFSET-ADJUSTMENT EQUATION

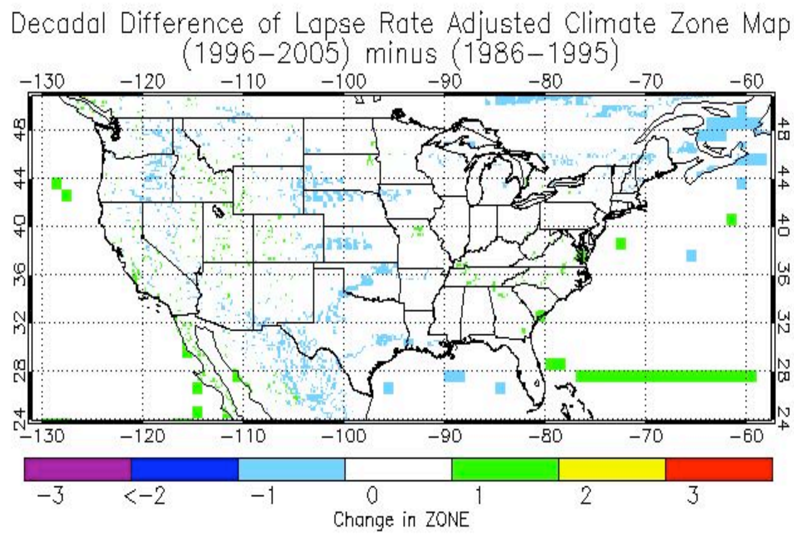
NOTE:
ASHRAE EQUATIONS WERE USED TO CONVERT FROM TMAX, TMIN, AND TAVG TO HEATING AND COOLING DEGREE DAYS.

DECADAL DIFFERENCES BETWEEN 10-MINUTE CLIMATE ZONE MAPS

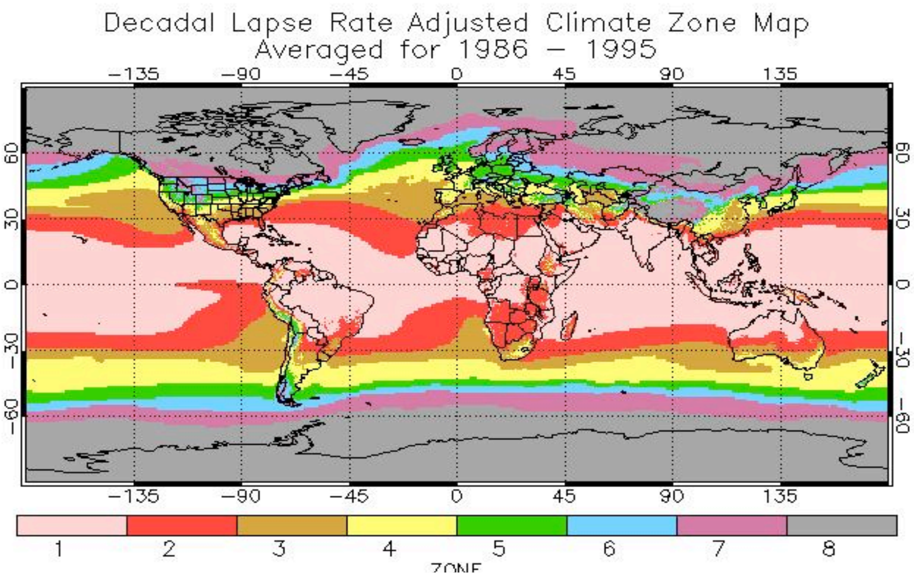


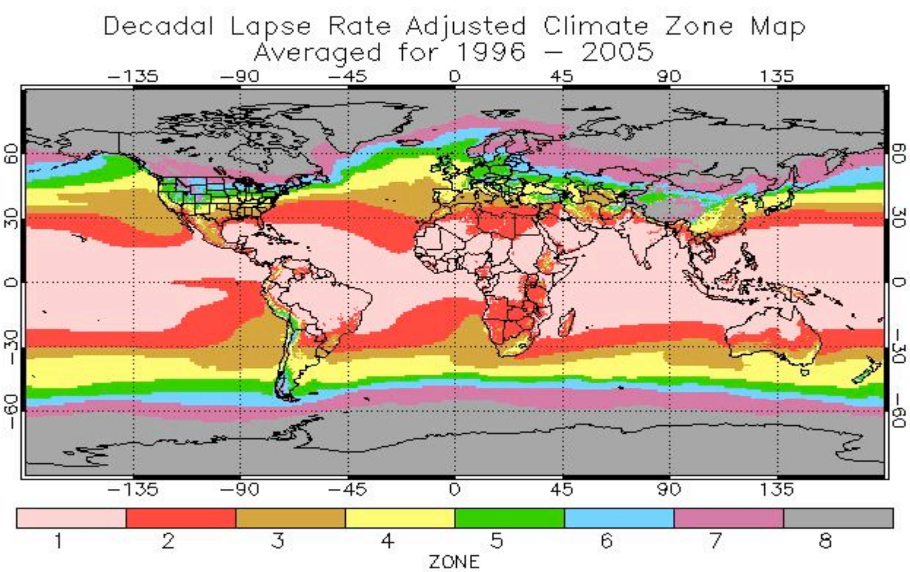
10-MINUTE LAT/LON NASA SPATIAL RESOLUTION (1996 - 2005)

SIMILAR TO 1986 - 1995 MAP BACK ON CHART 3

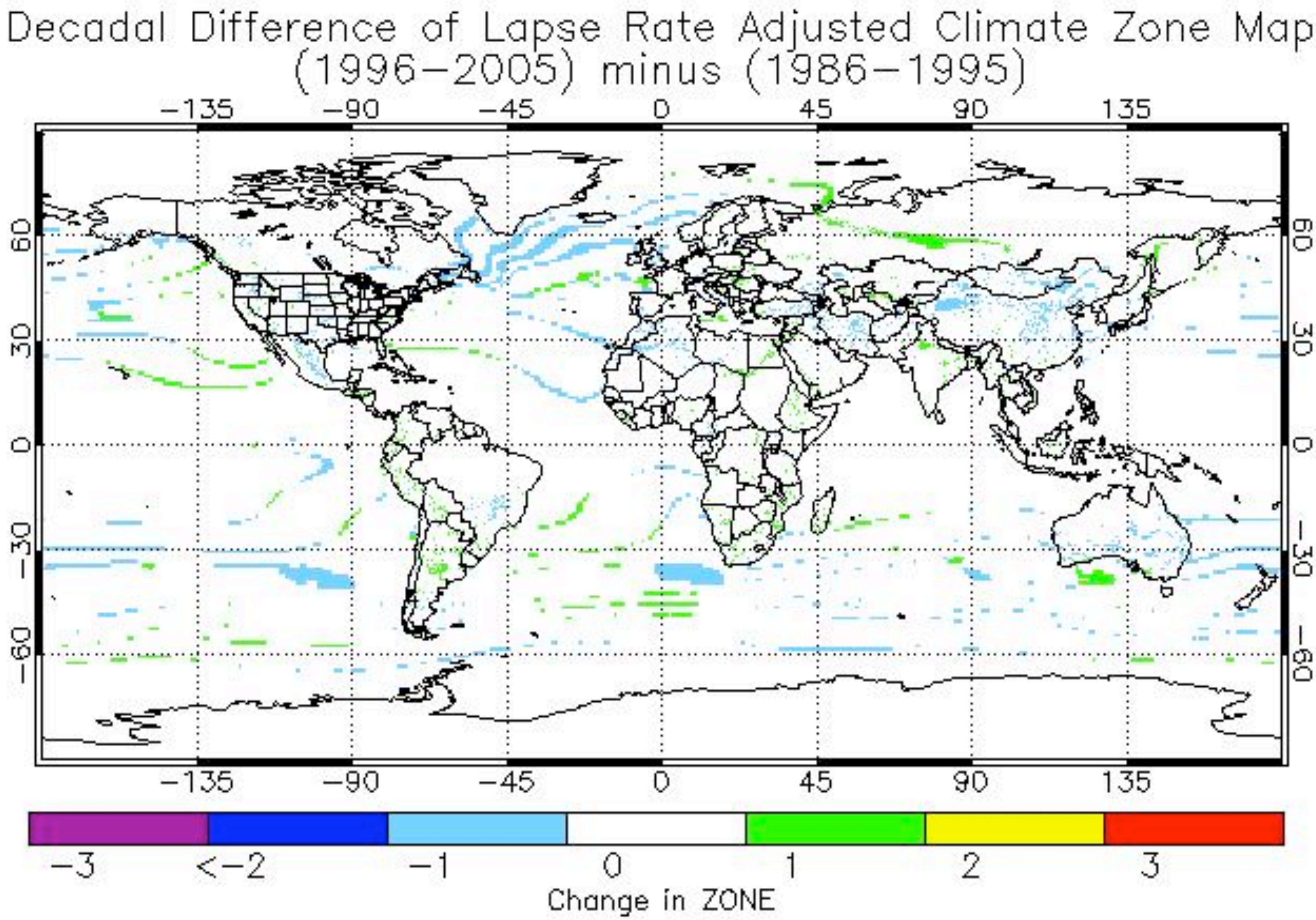


DECADAL CHANGE IN BUILDINGS CLIMATE ZONES APPEARS SMALL IN U.S.

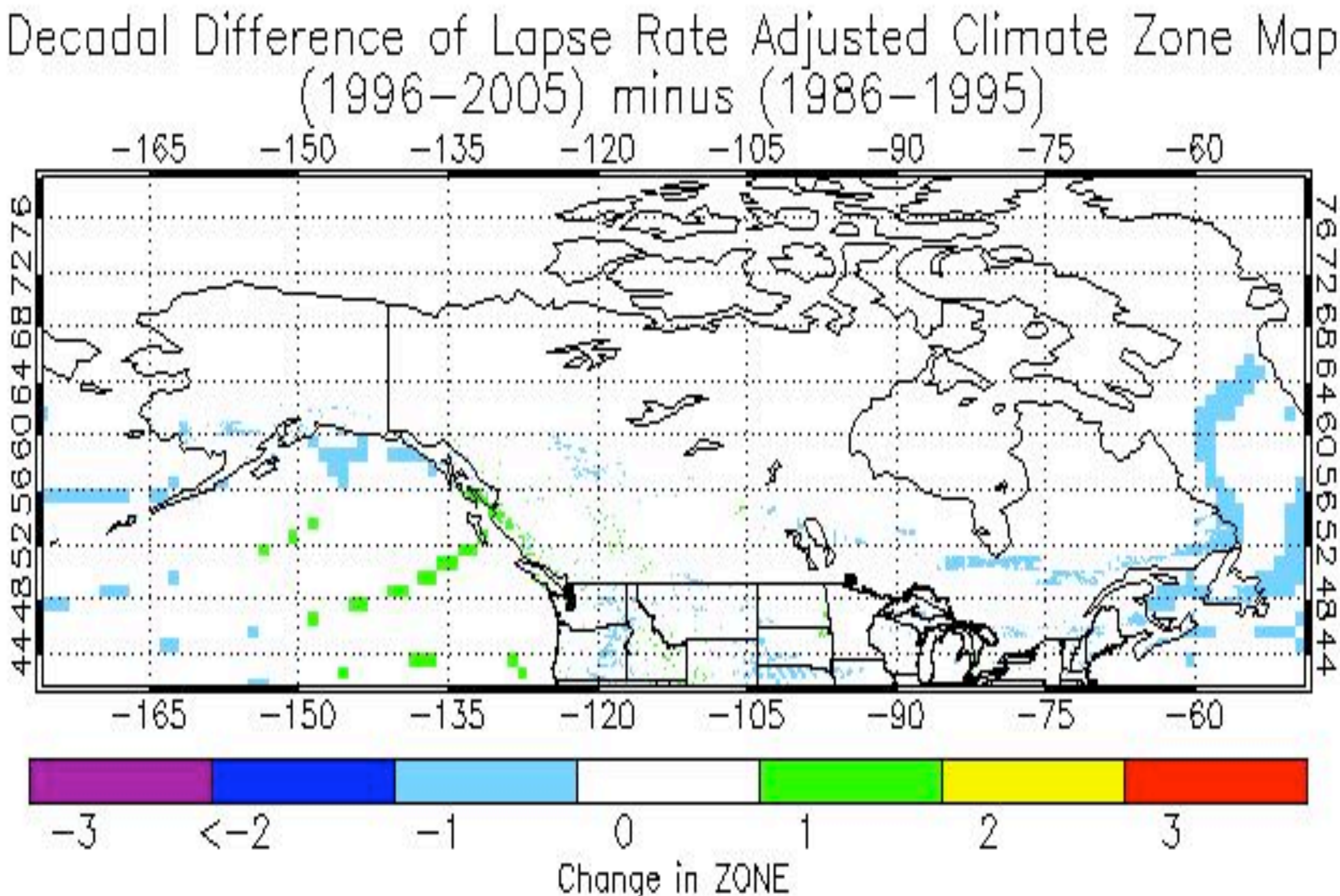




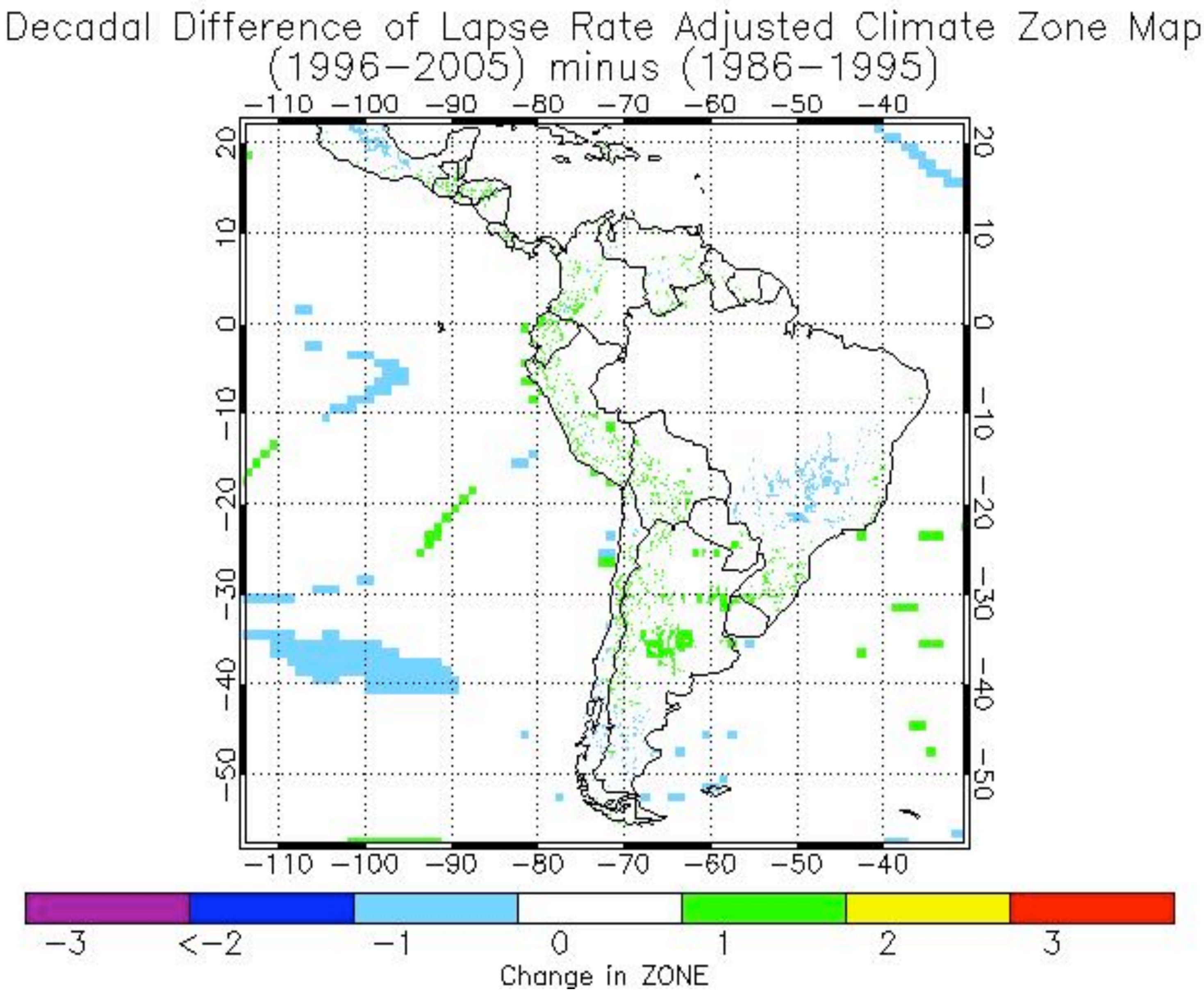
CHANGES BETWEEN DECADES ARE NOT APPARENT ON A GLOBAL SCALE <u>BECAUSE OF THE SCALE OF THE CLIMATE ZONE MAPS</u>


Decadal Difference of Lapse Rate Adjusted Climate Zone Map
(1996–2005) minus (1986–1995)
−135
−90
−45
0
45
90
135
60
30
0
−30
−60
−3
<−2
−1
0
1
2
3
Change in ZONE

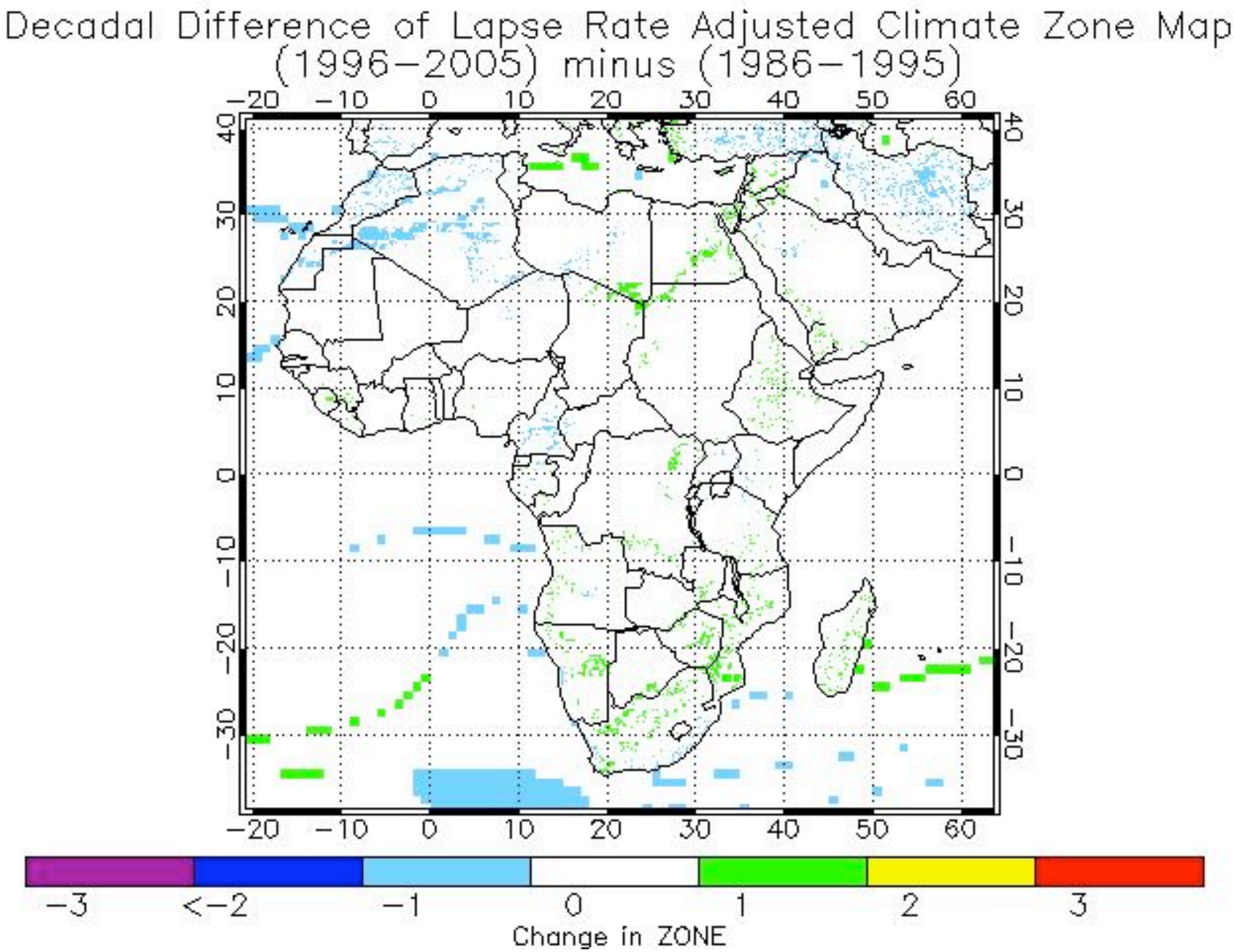
ALASKA AND CANADA BUILDINGS CLIMATE ZONE DECADAL DIFFERENCES



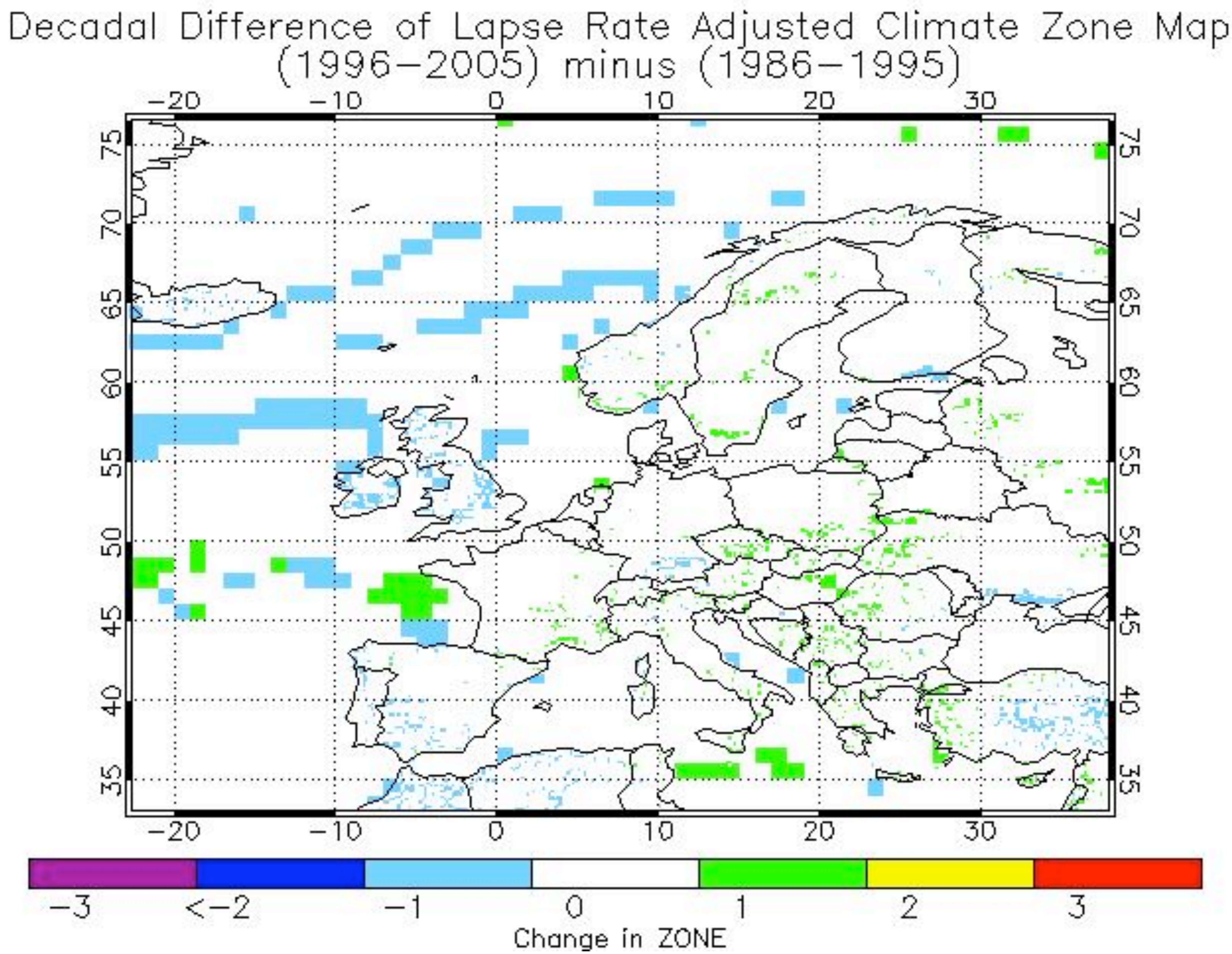
SOUTH AMERICA AND CARIBBEAN SEA



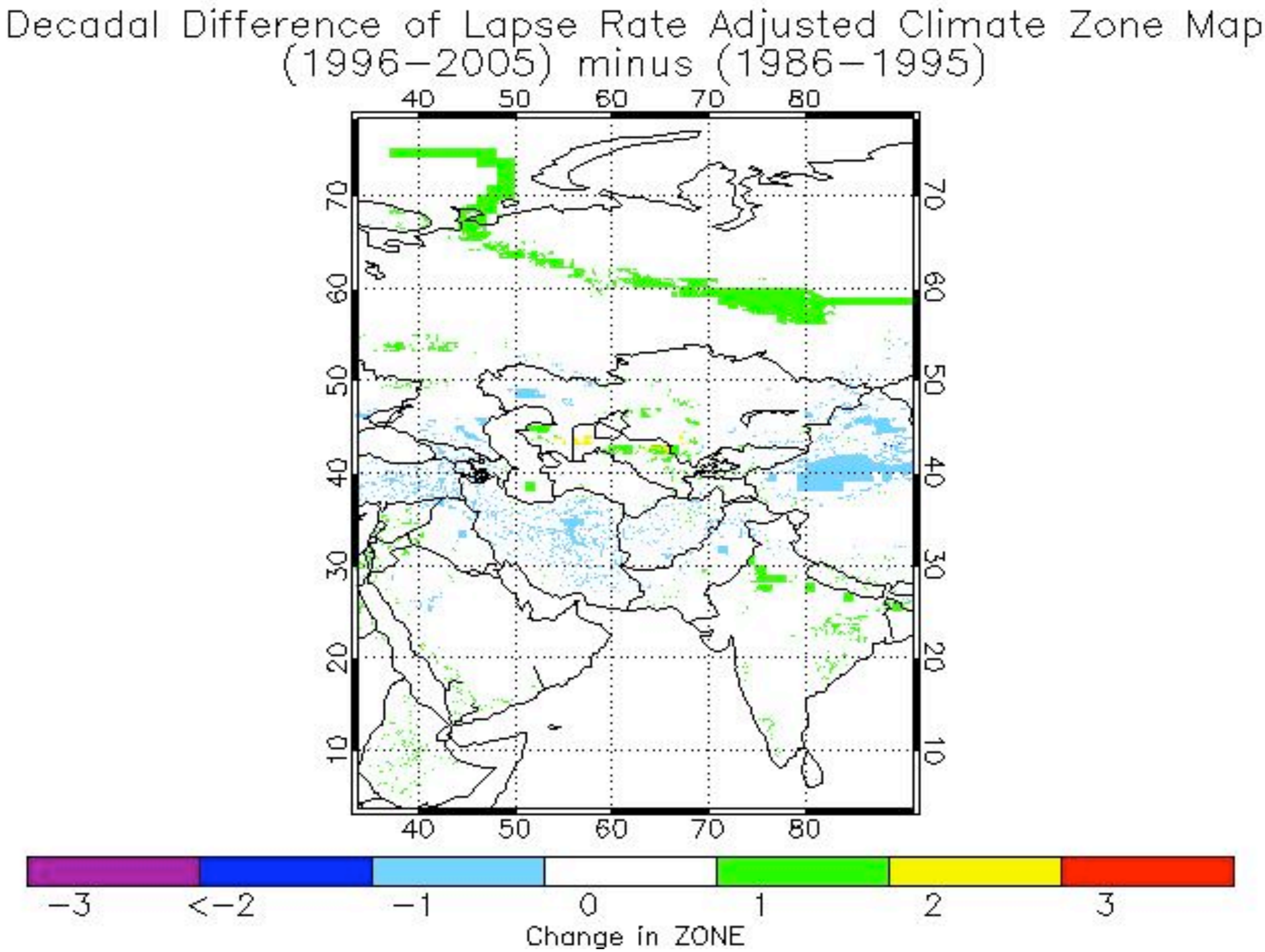
AFRICA, SAUDI ARABIA, IRAQ, IRAN, AND MADAGASCAR



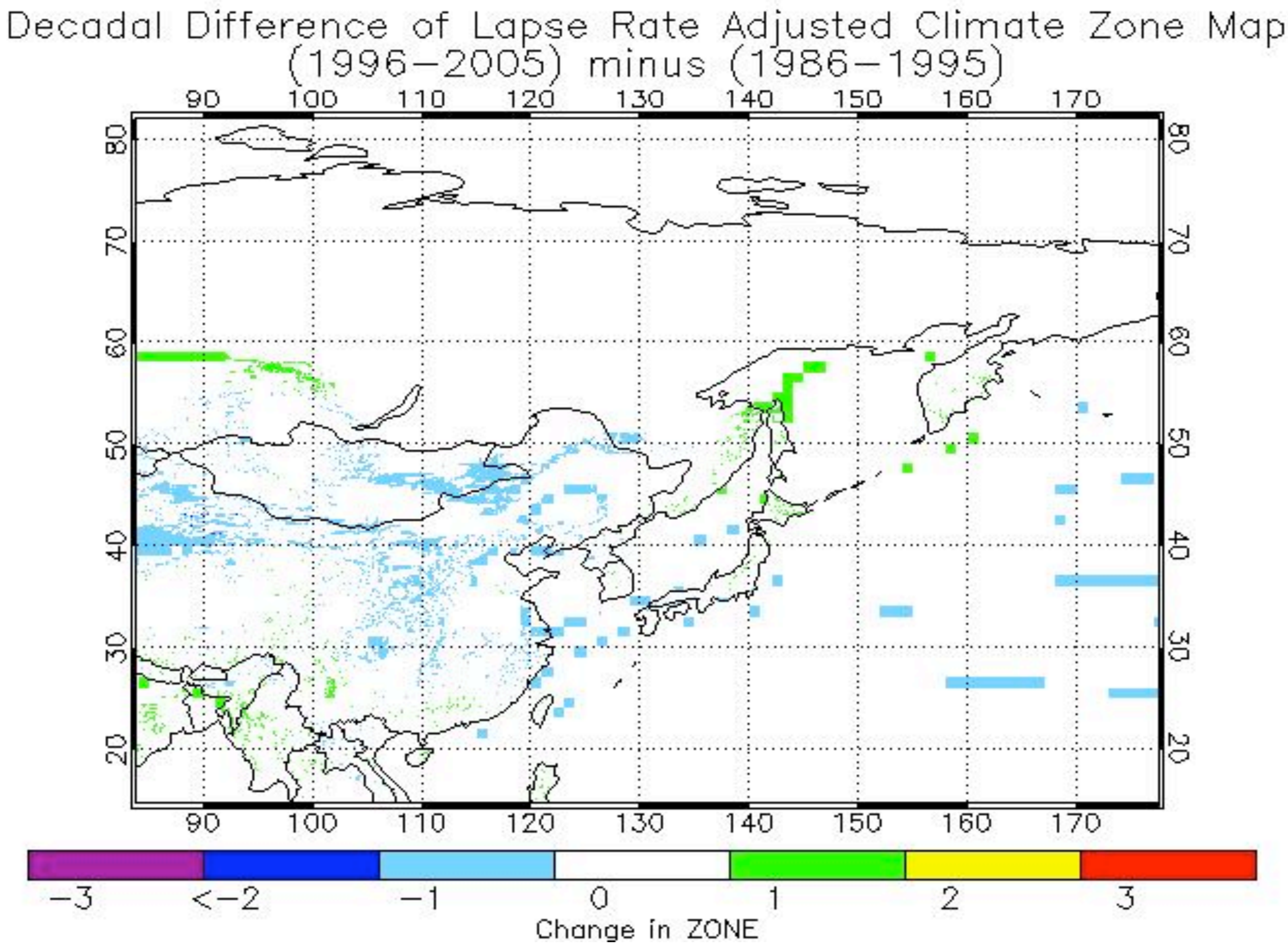
EUROPE


Decadal Difference of Lapse Rate Adjusted Climate Zone Map
(1996–2005) minus (1986–1995)
−20
−10
0
10
20
30
75
70
65
60
55
50
45
40
35
−3
<−2
−1
0
1
2
3
Change in ZONE

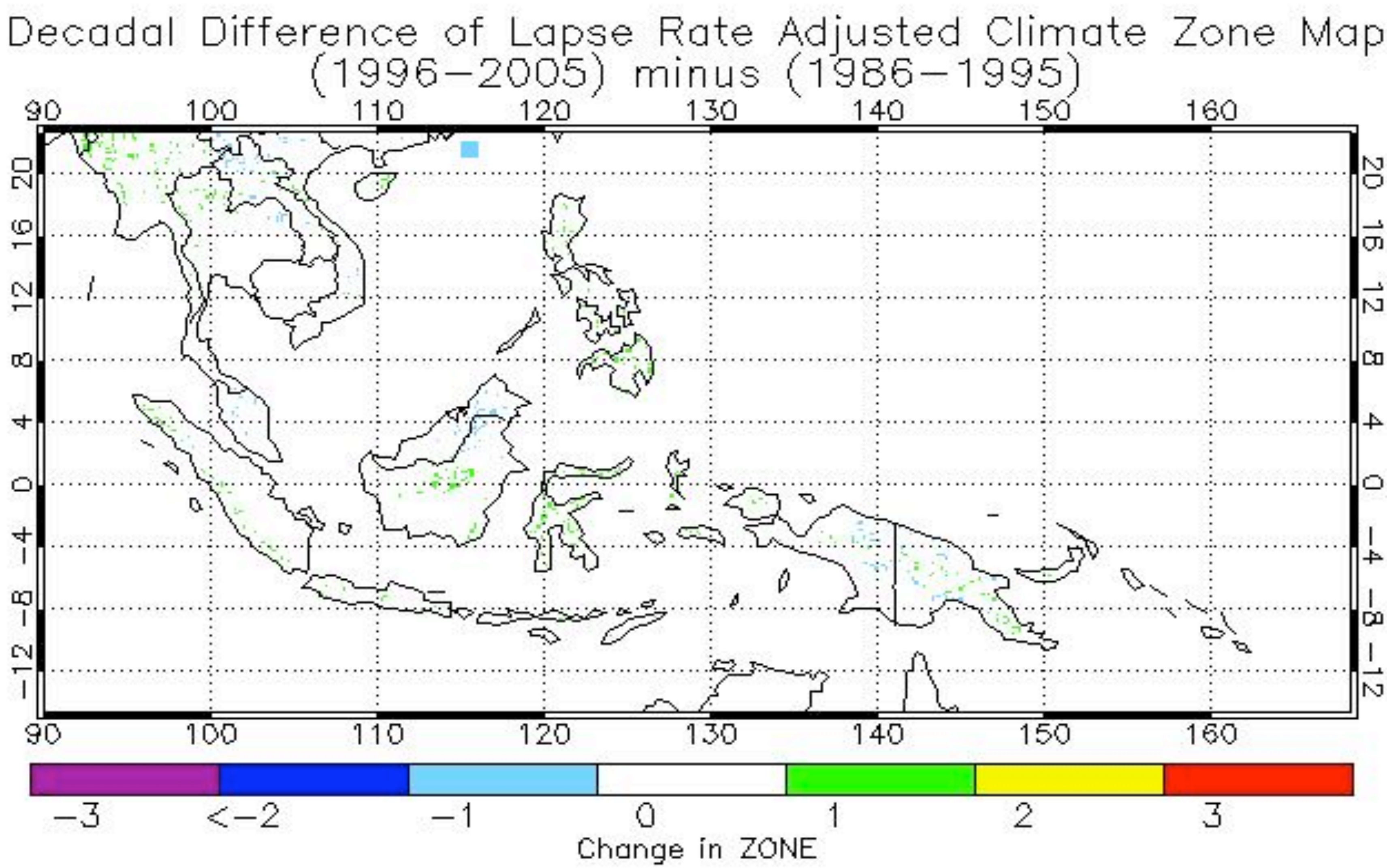
WESTERN ASIA



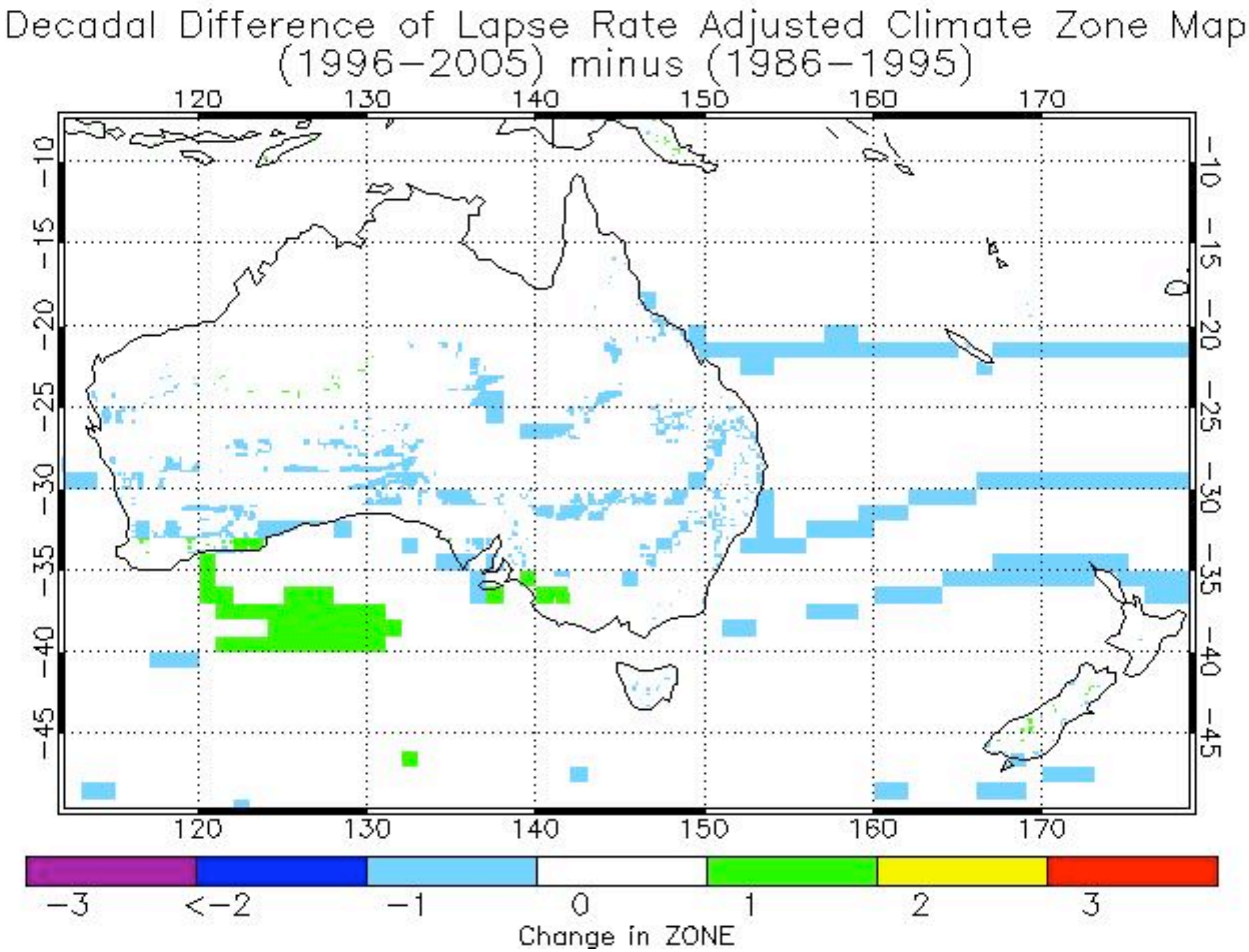
EASTERN ASIA: CHINA, TAIWAN, KOREA, JAPAN, RUSSIA, SIBERIA



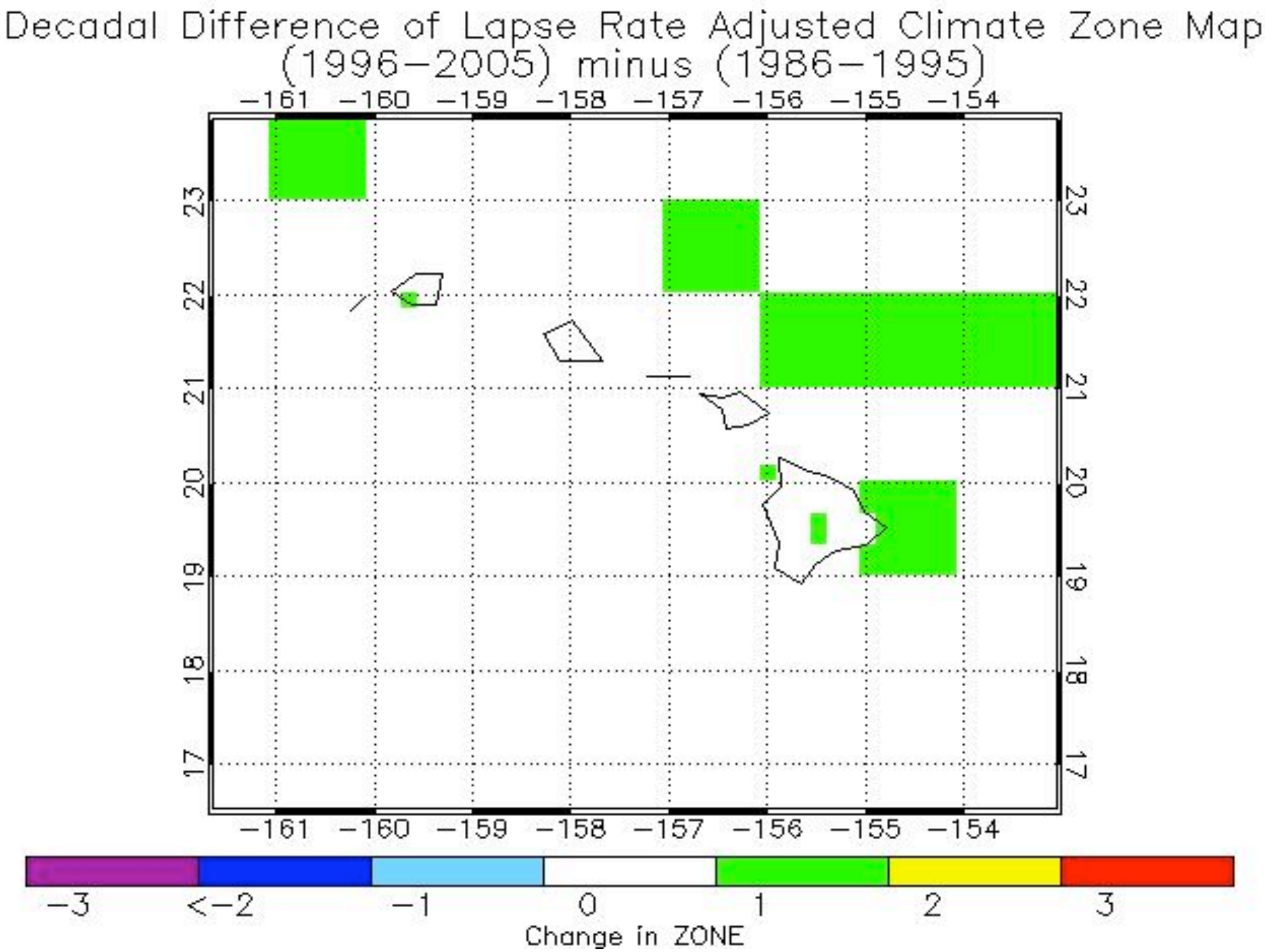
WESTERN PACIFIC: INDONESIA, MALAYSIA, VIETNAM, THAILAND, PHILIPPINES, AND PAPUA NEW GUINEA



AUSTRALIA, NEW ZEALAND, TASMANIA, AND NEW CALEDONIA



HAWAII


Decadal Difference of Lapse Rate Adjusted Climate Zone Map
(1996–2005) minus (1986–1995)
−161 −160 −159 −158 −157 −156 −155 −154
23
22
21
20
19
18
17
−3
<−2
−1
0
1
2
3
Change in ZONE

GLOBAL DECADIAL-CHANGE STATISTICS

(1996-2005 DECADE MINUS 1986-1995 DECADE)

NUMBER OF 10-MIN SIZE LAT/LON CELLS = 2,332,800 OVER GLOBE.

ZERO DECADAL BUILDINGS CLIMATE ZONE CHANGE = 95.8 %.

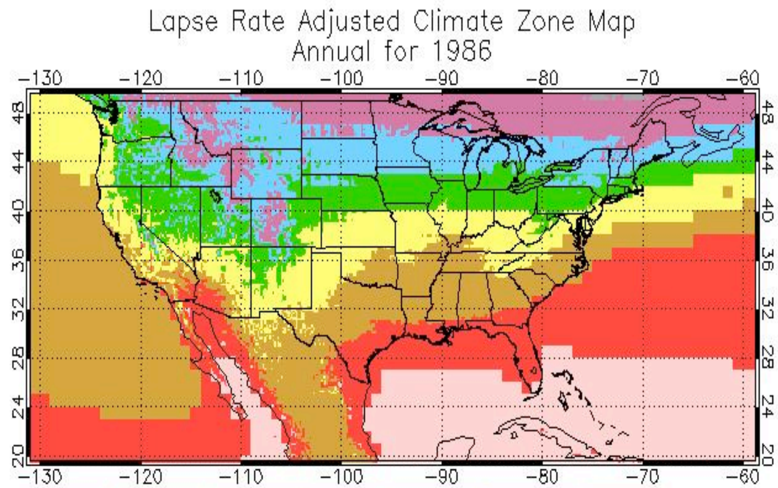
$\pm$ 1 DECADIAL BUILDINGS CLIMATE ZONE CHANGE = 4.2 %.

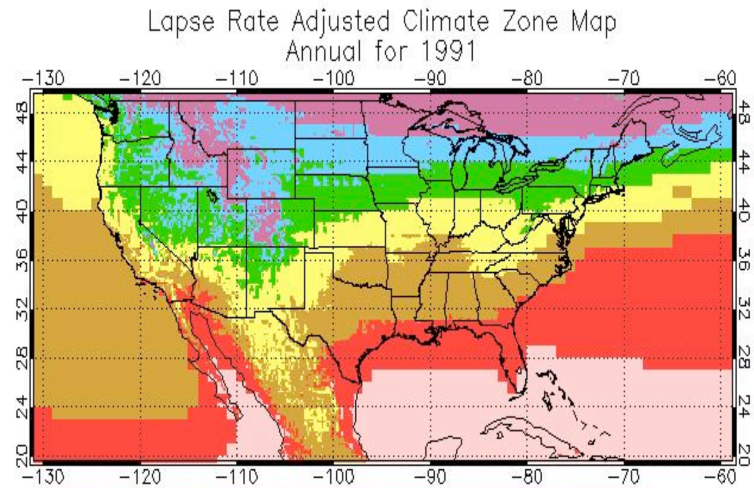
$\pm$ 2 OR $\pm$3 DECADIAL BUILDINGS CLIMATE ZONE CHANGES = 0.006 %.

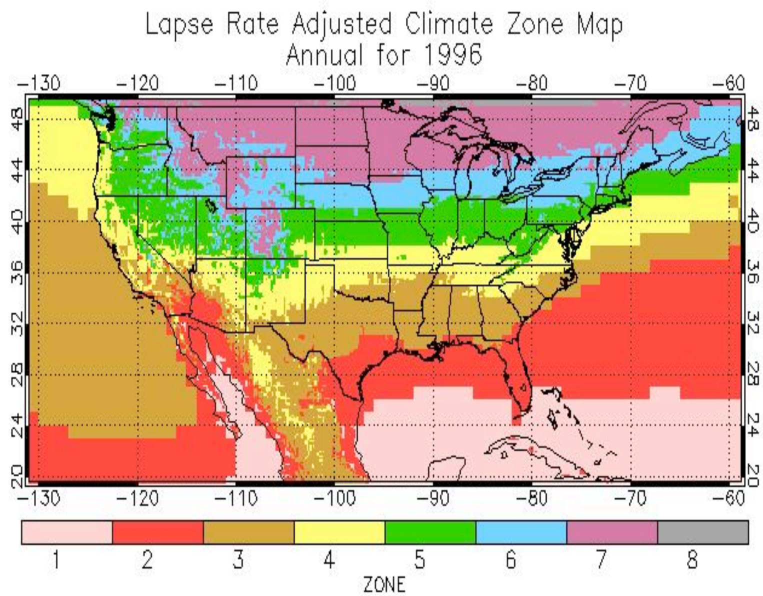
NOTE:

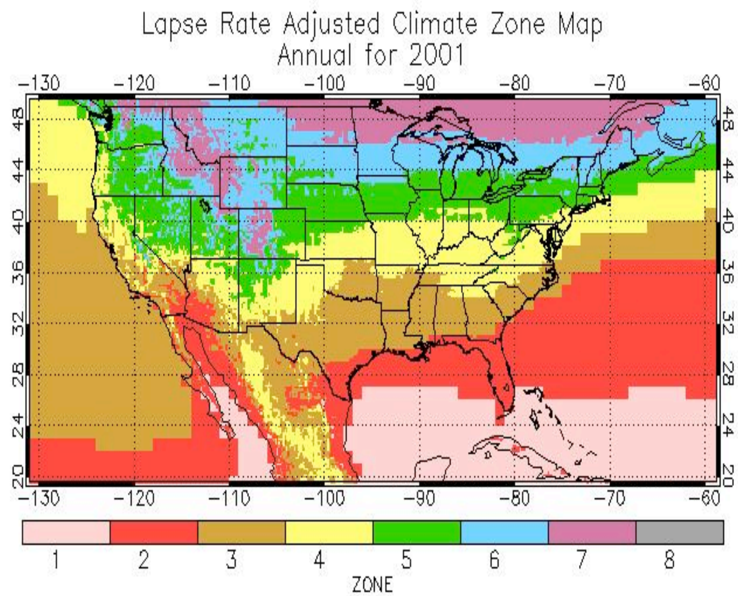
MANY $\pm$ 1 CHANGES ARE IN THE OCEANS AND APPEAR TO BE SHIFTS IN OCEAN CURRENTS.

INTERANNUAL VARIABILITY BETWEEN 4 SPECIFIC YEARS









CONCLUDING REMARKS

TEMPERATURES FOR NON-AVERAGE TOPOGRAPHY HEIGHTS WITHIN A COUNTY CAN BE ESTIMATED USING THE LAPSE-RATE/OFFSET EQUATIONS IN CHART 5. (THE BRIGGS, ET AL. PROBLEM IN CHART 2.)

CLIMATE ESTIMATES BASED ON USGS 10-MINUTE LATITUDE/LONGITUDE TOPOGRAPHY GIVE AN IMPROVED INDICATION WHERE BUILDINGS CLIMATE ZONE CHANGES MAY OCCUR.

REGIONS SUBJECT TO TOPOGRAPHY-INDUCED TEMPERATURE AND CLIMATE CHANGE HAVE BEEN ESTIMATED OVER THE GLOBE FOR TWO 10-YEAR PERIODS.

DIFFERENCES BETWEEN DECADAL CLIMATE ZONES ARE USUALLY WITHIN ONE CLIMATE ZONE (CHARTS 8, 10, 11,12, 13, 14, 15, 16, 17, 18, AND 19).

YEAR-TO-YEAR INTERANNUAL VARIABILITY MAY BE MORE SIGNIFICANT.